calcareous rocks belonging to the Cambrian system may yet be found; but considerable doubts may be entertained of their occurring in it to any extent except as methylosed members.

The facts brought to light by the various submarine surveys that have been made show how simple, yet grand, are the depositional phenomena of the ocean; but they place before the geologist nothing more than the materials that enter into the composition of ordinary sedimentary rocks in their *normal* condition. During the Wernerian stage in the progress of geology the doctrine was taught that crystalline rocks were the products of oceanic precipitations. Other doctrines took its place. Of late years, however, it has been revived, with novel accessories. Judging from the results of the surveys referred to, the chances seem to be extremely remote that any sea-bottoms will ever yield to the dredge samples of *direct crystalline precipitates* having the least relation to the Laurentian diorites, ophites, syenites and the like, as products of our present oceans.

XXVII.—*Remarks on Professor Owen's Arrangement of the Fossil Kangaroos**. By Gerard Krefft†.

The first part of Professor Owen's work describing the fossil kangaroos has just been received; and as some new genera have been added, it will no doubt interest readers of the 'Sydney Mail' to hear how these divisions have been defined. The learned Professor pays a just tribute to John Gould, F.R.S., "through whose adventurous journeys, and by the noble works in which he has given the result of his observations in Australia and Tasmania, we mainly know the extent and kinds of variations under which the kangaroo there exists." There is more in this sentence than many people imagine, because Professor Owen no longer hesitates to speak "evolutionally" ‡ about the subject. It has been pointed out by me on several occasions, and chiefly in papers read before the Royal Society of New South Wales, that the whole of our extinct and living marsupials were offshoots or branches of a kind of animal which combined the dental structure of both the carnivores and herbivores of the marsupial section. The

* "On the Fossil Mammals of Australia.—Part VIII. Family Macropodidæ: Genera *Macropus*, *Phascolagus*, *Sthenurus*, and *Protemnodon* (Phil. Trans. 1874, pt. i. pp. 245–287, pls. xx.–xxvii.), by Professor Owen, F.R.S.

† From the 'Sydney Mail,' Dec. 26, 1874. Communicated by the author.

‡ Royal Society's 'Philosophical Transactions' for 1874, p. 255.

Thylacoleo was the last representative of this early progenitor of our marsupials; and in this form only occur carnivorous grinders with an otherwise herbivorous dentition. There must have been numerous intermediate forms totally lost, or not yet discovered, which would clear up our doubts upon the subject; so much is certain, however, that with the *Thylacoleo* disappeared the nearest relation of the most ancient form of marsupial life in this country.

Supposing, then, this hypothesis to be correct, we can well account for the development of the rest of the pouched tribe, and simply divide them into two groups,—No. 1 embracing all the members with a pair of small conjointed inner toes—that is, kangaroos, rat-kangaroos, wombats, phalangers (opossums, flying squirrels, native bears, &c.), and bandicoots; whilst No. 2, on the other hand, comprises the true flesh-eaters, without the conjoined inner pair of toes, such as the Tasmanian tiger and devil, the dasyures or native cats, and the small fry of pouched mice.

All our marsupials can be received into one or the other of these groups; so that, after all, the classification of them is easy enough. It may be argued that the dentition varies much; but when we study embryonic life and the development of the teeth, we soon find the missing links; and if a person will only take the trouble to look for himself before implicitly believing what is published, he will soon change his opinion. Let us take a wombat, an opossum, and a bandicoot for a comparison: and certainly there are not three animals in the group more different from each other than these; but all three possess the conjoined toes to the hind feet. When the teeth of a very young wombat are examined, it becomes also clear that they are furnished with crowns or working-surfaces which very much resemble those of our common phalanger or opossum; and when we take the trouble to disengage the grinders of certain bandicoots, such as the *Peragalea* or rabbit-rat, we behold a "small edition" of a true wombat's grinders. Of course it is necessary to find out such things by actual examination; and it must be admitted that few persons have the opportunity, or, if so, make use of it.

The native bear is the diminutive representative of the gigantic extinct Phalangers, the Diprotodons, and Nototheres; and he is also the most ancient living form of marsupial life, probably connected by innumerable unknown species with the lower section to which the platypus belongs. At any rate, there is no other animal known to me which, at an early period of its existence, has grinders resembling the horny "apologies for teeth" wherewith our "duckbill" is supplied

when adult. Of course the resemblance is remote, very much so; but there is a resemblance nevertheless. Again, we have rat-kangaroos, which (when despatched in skins without skulls) have been taken more than once for bandicoots by the best European authorities; and there were kangaroos once upon a time which had firmly joined lower jaws, and others with compressed grinders, not unlike the carnivorous marsupials. These two latter groups are not referred to by Professor Owen in part viii., and they will probably be discussed at some future time.

The Professor's treatise is illustrated by eight splendidly executed plates of the newly created genera, some of which represent unique specimens from the Australian-Museum collection; and so faithfully executed are they, that I recognized the figures at a glance, though I have not had an opportunity to look at the originals for six months and more. Professor Owen has found it necessary to alter the existing arrangement of the kangaroo tribe, retaining the term *Macropus* for all the kangaroos proper, for the wallaroos (*Osphranter*), and for the wallabies (*Halmaturus*) and rock-wallabies (*Petrogale*). It appears, however, that, if we must subdivide the fossil species into several genera, we cannot well discard the arrangement formerly proposed and generally adopted*, which is simple, comprehensive, and meets all our wants.

This arrangement is as follows:—

Genus Macropus.

Large kangaroos with small premolar teeth, which are soon lost.

Genus Halmaturus.

Kangaroos of smaller size, with permanent premolar teeth. This second group is capable of subdivision into four genera or subgenera, and the last, the rat-kangaroos, into two more.

Of course it rests with naturalists which system to adopt; but as few museums have so extensive a series of kangaroo skulls and skeletons as our own, we must have some voice in the matter, and cannot be expected to change our arrangement except upon more solid grounds than those given in Professor Owen's comprehensive paper.

Looking at the splendid drawings, we miss one of the chief characteristics of a kangaroo's skull; and that is the upper incisive dentitions of the fossil species †. Without this, a proper

* 'Australian Vertebrata, Fossil and Recent,' by Gerard Krefft, p. 10.

† I have seen some proof-plates of skulls of Prof. Owen's second part of the Macropodidæ without the important *incisive dentition*; but I do not think that the shape of the teeth, as indicated by faint lines, is correct.—G. K.

classification cannot be attempted; and it is much to be regretted that the author had so little material at his command at the time. Since the work was published, Professor Owen has received numerous additional proofs, through his chief contributor and friend, Dr. George Bennett, and amongst these at least a dozen fragments of skulls, with the incisors perfect or nearly so. The grinding-series differs much in some groups; and seldom can a pair of skulls be found which have the teeth alike. The grinders are always subject to more than the usual variation; and for this purpose large quantities of skulls were brought together and examined here before classification was attempted. The result led to the conclusion that by the upper front teeth only (of half-grown or almost adult individuals) can skulls be named with certainty. There are two kinds of third upper incisors which occur with premolars of a certain form; and this sanctions the division into two large groups as above, with the following additional characteristics.

1. Macropus.

With a broad third upper cutting-tooth (without a fold or groove when adult), with deciduous premolars, and subject to shedding the grinders up to a single pair in each ramus in old age.

2. Halmaturus.

With rather narrow and grooved third upper incisors and a more permanent dentition, the grinders being worn down but seldom shed. Besides this distinguishing point, the distance between the lower incisor and the premolar must be considered; and the wider this space, the sooner the teeth are reduced in number; the shorter, the longer are the grinders retained.

Compare this space in a wallaby's jaw with that of a kangaroo, and the difference will be understood at once. A long-headed kangaroo sheds the grinders, whilst a short-headed wallaby wears them out.

To illustrate this it is necessary to refer to the author's splendid illustrations. On plate xx. we have a long-headed kangaroo (under fig. 1), certainly with a short upper third incisor, but with every indication that the grinders will be shed with age and not worn down. Figures 13 and 15 represent similar animals, who shed their teeth; but No. 11 (a rock-wallaby's lower jaw) belongs to the "grinding-down" section, and in this the space between incisors and molars is very short.

On plate xxiv. (figures 10, 11, and 12) the lower dentition of our black wallaby is given. The wear of the incisor below, and the corresponding teeth above, shows that the animal was fully adult, but had not shed the premolar, as true

kangaroos invariably do about that period. Figure 1, representing the skull with a front tooth lost, proves, first, that the author had not the material required; otherwise a more perfect figure would have been given; it also shows that the value of the upper incisors as a means of classification is reduced with age, because the incisors, being much worn, lose their original shape completely.

On plate xxv. fine illustrations are given of *Protemnodon Anak*—that is, of a gigantic wallaby who kept his teeth and ground them down, but did not shed them as kangaroos do; this is, of course, a member of the genus *Halmaturus*, as we have hitherto classed the tribe. Suppose we designate this creature as *Halmaturus* (*Protemnodon*) *Anak*. It appears, from remarks on page 261, that the author desires to retain the genus *Osphranter*; but a definition of the characteristics of the genus are not given. Mr. Gould founded it on external characters only; and not having a skull at my command, particulars cannot be furnished. There is no doubt that wallaroos identical with the present wallaroo which inhabits the Clarence district, once existed and left their remains in the Wellington caves; Professor Owen mentions their presence on the Darling Downs also.

The genus *Phascolagus* is mentioned as being found in a fossil state by Dr. Bennett in Queensland. This form occurs living far north, where Mr. George F. Waterhouse, of the Adelaide Museum, obtained the typical specimen. It appears to be a link between the wallabies and kangaroos proper, the head being long; but the third upper incisor is a narrow tooth, and therefore the animal does not correspond with the kangaroos proper, which have broad third upper incisors. The genus *Boriogale* is referred to in several places on pages 263 and 264, founded on anatomical points of the skull, which cannot be distinguished without specimens. As far as I can remember, the teeth resemble those of the wallaroo. The large fossil wallaby, hitherto known to us as *Macropus* (or *Halmaturus*) *Atlas*, is now classed under the designation of *Sthenurus Atlas*. This is also a true wallaby, the form of whose lower premolar teeth approaches those of certain extinct phalangers of the genus *Nototherium*. Several new species of each genus are described in the treatise, which can be referred to at the Public Library.

The next part of the learned author's work will probably bring the kangaroo tribe to a close; and we may confidently expect to see figured therein some of the well-preserved specimens forwarded by Dr. Bennett during the last six months. Surveying the part as a whole, it must be considered a

splendid addition to the elucidation of Australian natural history; and it is to be hoped that another grant will be made by our liberal Legislature to enable the author to finish his great undertaking.

XXVIII.—*Zoologico-Embryological Investigations.*

By M. Ussow.

[Continued from p. 113.]

IV. *Appearance of the Organs.*

We may now pass to the second period *, that of the production of the organs. On the first day of this period (in *Sepiola* and *Loligo* the ninth day from the beginning of the process of segmentation) the rhomboidal groove already described gradually becomes deeper, and covered over by the elongate-ovate constantly growing fold, which is separating by constriction at the ventral side and assuming the form of a shield. Towards the end of this period the margins of the fold begin to grow together, and the rhomboidal groove becomes converted into a flat tube, somewhat broader in the middle (especially in *Sepia*).

The scutiform hill-like elevation (originating from the coalesced fold) which lies over the tube chiefly on the dorsal surface, and which is gradually constricted, is the rudiment of the *mantle*; whilst the *os Sepiæ* will subsequently be formed in the above-mentioned tube closed at both ends and widest in the middle (*Sepia*, *Loligo*, *Sepiola*, *Ommastrephes*, *Rossia*). The elevation, separating by constriction at the ventral side, grows both upwards and downwards, and acquires first the form of a cup and then that of a cylinder.

The walls of the so-called primitive groove †, which is con-

* In *Loligo*, *Sepiola*, and *Argonauta* the second period of development lasts five days. In this paper I follow Metschnikoff's division of the development of the Cephalopoda into three consecutive periods:—first, the formation of the germ-lamellæ; second, the appearance of the organs; third, the gradual further development of the organs.

† The position of this rhomboidal depression upon the dorsal surface, its early appearance (before all the organs), its further mode of development, are all facts which remind us of the primitive groove of the Vertebrata: and taking them into consideration, it may likewise be called the primitive groove, although as a matter of course there can be no question of comparing it more closely with the primitive groove of the Vertebrata, as the two rudiments represent fundamentally different organs. Although a groove is also at first formed in the Octopoda (*Argonauta*), this does not become closed (except in the genus *Cirrhoteuthis*?), but becomes gradually effaced and finally disappears entirely. With regard to *Argonauta*, I must remark that Kölliker has described and figured the groove (*l. c.* p. 163, Taf. vi. figs. 71–73) as "a rather deep, funnel-shaped pit."